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Review of Giant Reed (*Arundo donax)*

Arundo donax L. (giant reed, bamboo reed, giant cane, river cane, arundo) is one of the largest grass species, growing 8-10 m tall in dense, many-stemmed clumps arising from shallow, horizontal rhizomes (Perdue, 1958). Found in many subtropical and warm-temperate areas of the world, the exact origin of this species is unclear. It is naturalized in the Mediterranean Region and sometimes reported as native to that region, but more recent research indicates that it probably originated on the Indian subcontinent (see Else 1996; Bell, 1997; Dudley, 2005).

Giant reed has been nominated as one of the top 100 Worst Invaders of the World by the Invasive Species Specialist Group of the World Conservation Union (http://www.issg.org). It was first introduced to the United States by Spanish colonists in the 1700's (Newhouser et al., 1999) and introduced again to California in the early 1800's for erosion control in drainage canals (Bell, 1997). It is now a major invasive threat to riparian areas in California as well as other southwestern states and is listed as one of the twenty most invasive weeds in California (Bell, 1997; CalEPPC, 1999; Wijte et al., 2005) and as a noxious weed in Texas (Texas Administrative Code).

Generally considered to be a hydrophyte, giant reed achieves optimal growth when growing near water. However, it easily adapts to many ecological conditions and soil types, and once established is quite drought tolerant and is capable of growing in fairly xeric conditions (Hoshovsky, 1987; Lewandowsky et al., 2003). It also tolerates saline conditions and can grow near the coast (Else, 1996; Dudley, 2005). Giant reed is a C_3 plant, yet it displays the unsaturated photosynthetic potential of C_4 plants, and is capable of extremely high photosynthetic rates (Papazoglou et al., 2005). This, in combination with high water use and relatively good water use efficiency result in giant reed being one of the most productive plant species in the world, growing up to 10 cm per day under optimal conditions (Perdue, 1958; Bell, 1987; Newhouser et al., 1999). As a result, the potential to out compete neighboring plants is quite high.

Reproduction - Giant reed blooms during the summer and fall; however, there is no record of viable seed production in the US (Bell, 1997; Wijte et al., 2005). This species is capable of producing viable (wind-dispersed) seed in its native habitat, although the extent of successful sexual reproduction is unclear (Lewandowski et al., 2003). Research regarding the mechanism of seed sterility and the potential for production of viable seed in the US has yet to be conducted.

Due to the lack of viable seed, reproduction of giant reed in this country is limited to vegetative means. Individual stands expand up to 0.5 meters per year through rhizome growth and addition of stems (Dudley, 2005). Dispersal occurs through transport of rhizome or stem fragments which readily sprout at new locations (Bell, 1997; Wijte, 2005). Flood waters are the most common means of transport (Else, 1996; Bell, 1997); however, improper disposal of plants and transport on machinery used for eradication has become a problem in some areas of the West (Dudley, 2005; Wijte et al., 2005).

Studies have shown that virtually any segment of stem or rhizome, even if split sideways, can sprout and grow into a new plant if it possesses an axillary bud (Boose and Holt, 1999; Wijte et al., 2005). Buds occur at the stem nodes (12-30 cm apart) and approximately 5-10 cm apart on the rhizomes (Wijte et al., 2005).

Rhizomes display high regeneration potential year round (Decruyenaere and Holt, 2001), while stems show a seasonal depression in sprouting potential when temperatures fall below approximately 17 C (Boose and Holt, 1999; Wijte et al. 2005). A fairly high percentage of both rhizome and stem fragments remain viable for at least a month after separation from the parent plant, even with significant desiccation (Else, 1996; Boose and Holt, 1999). Boose and Holt (1999) reported that 50% of rhizomes stored for four months under moist conditions sprouted.

Rhizomes typically grow within 5-15 cm of the soil surface but are capable of sprouting from up to one meter deep (Else, 1996). Stems are more sensitive to burial under soil and reduced sprouting of stem fragments was observed at depths as low as 10 cm (Boose and Holt, 1999).

Ecological impacts – Giant reed has become an invasive threat to riparian, wetland and coastal areas of the Southwest (Else, 1996; Bell, 1997; Wijte et al. 2005). It has also invaded areas of the Caribbean (Kairo et al. 2003), Hawaii and other Pacific Islands as well as several habitats in Australia (Dudley, 2005), indicating that the invasive threat of this species is not limited to wetlands of semi-arid regions. Anecdotal references suggest that, in general, ornamental plantings of giant reed in the Southeast have not been highly invasive. However, localized and scattered infestations of giant reed are present across the Southeast and the invasive potential, especially with added sources of introduction, is unknown.

Several traits of giant reed pose potentially significant ecological threats. Riparian and other wetland habitats are especially susceptible to invasion by giant reed if rhizome or stem fragments are introduced via flood waters or other means (Else, 1996; Bell, 1997). The extremely rapid growth and dense growth habit of giant reed result in dense shade and eventual displacement of plants in the understory. In areas where it has become well established, giant reed has reduced native plant biodiversity (Hoshovsky, 1987; Else, 1996; Bell, 1997).

The stems and leaves of giant reed contain numerous secondary compounds, making it naturally pest resistant (Bell, 1997; Lewandowsky et al., 2003). This is an attractive trait for agronomists as fewer pesticides are required to cultivate this species, but results in poor quality habitat for insects, birds and other wildlife (Bell, 1997; Herrera and Dudley, 2003). In addition, the canopy structure of giant reed results in less shading of streams than occurs with a tree canopy. As a result, water temperatures are higher, potentially impacting water quality and aquatic biodiversity (Iverson, 1993; Bell, 1997).

In the Southwest, giant reed is highly flammable during most of the year (Bell, 1997). As a result, riparian zones which typically serve as fire breaks may become prone to wildfire when infested with giant reed (Scott, 1993). Its ability to quickly re-sprout after fire may promote the invasive potential of giant reed and riparian zones infested with giant reed may become fire-defined systems as opposed to flood-defined systems, completely altering the character of the ecosystem (Bell, 1997). Whether the higher relative humidity typical of the Southeast will reduce the fire threat of giant reed is unknown.

Another trait which may be of greater concern in semi-arid regions, but can still be important in the Southeast is that giant reed has a very high rate of water use (Iverson, 1993). Stands of giant reed may reduce the amount of water available to neighboring plants and may impact the watershed water balance, especially during drought years.

Control – Large infestations of giant reed are difficult to eradicate given that all rhizomes must be removed or killed to prevent re-sprouting (Bell, 1997). Typically a combination of mechanical removal and application of a systemic herbicide (glyphosate) provide the best control (Bell, 1997; Boose and Holt, 1999; Newhouser et al., 1999). Care must be taken to ensure that removed plant material does not sprout (Boose and Holt, 1999; Wijte et al., 2005). The USDA ARS program is in the preliminary stages of searching for biological control agents for giant reed (Stelljes, 2001).

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